mal" and "pollution" ecology of ten groups of freshwater invertebrates, primarily benthic macroinvertebrates, that traditionally have been used as pollution indicators. The ten papers are organized along taxonomic lines, and the emphasis is on North American organisms, although Sawyer's paper contains some discussion of European species of leeches. Several of the papers contain useful summaries of current systematics of the groups they discuss. There are also good reviews of the ecology of some minor taxa of freshwater invertebrates that often are omitted or overlooked in pollution surveys and ecological studies. Bushnell's paper on the Ectoprocta contains some interesting observations on the life history and ecology of this phylum. In addition, the paper includes new data on the acute toxicity to several bryozoan species of some heavy metals, pesticides, herbicides, and sewage.

Although the emphasis in most chapters is on single-species comparisons, Cairns's chapter on the Protozoa makes a strong case for considering the entire microbial community in pollution surveys designed to monitor water quality and in laboratory bioassays to assess potential pollutants. His use of microcosms colonized with protozoan communities from natural waters appears to be a promising approach for assessing the effects of complex effluents on the structure of a freshwater community despite the problems associated with sampling and identifying members of this phylum.

Even though most of the authors recognize the shortcomings of the indicator-species concept, the theme of most chapters is species-by-species comparisons (typically based on only one stage of the life history) of sensitivity to water quality parameters or ranges of parameters of the waters from which the species were collected, or qualitative comparisons of species composition in "polluted" waters. This emphasis points up the lack of the ecological data that are necessary for the assessment and prediction of the environmental consequences of modifying the physical, chemical, and biological integrity of aquatic ecosystems. Although the use of indicator species clearly is the simpler method for assessing the impact of pollutants, it lacks the sensitivity and broader applicability of the more complex community and ecosystem analysis approach taking into account both micro- and macroinvertebrates. Moreover, in such a community approach both primary and secondary effects can be considered. The community approach is more difficult and requires more taxonomic specialists, but the chapters in this book indicate that too little is known regarding both the normal and pollution ecology of most freshwater invertebrates to warrant reliance on a few species as pollution indicators.

This book provides a useful summary of the ecology of many freshwater benthic invertebrate taxa despite the fact that most of the reviews are cursory. Unfortunately, the aquatic insects, about which more is probably known in terms of normal and pollution ecology, receive a superficial and biased treatment. An adequate review of the ecology of aquatic insects would, however, require a volume in itself.

Pollution biologists still should find this book a useful reference. Strict application of ambient water quality parameters presented in this volume as measures of either limiting conditions or safe limits for the various taxa should be done with caution, however, because most of the values are based on limited surveys of polluted environments and thus do not necessarily represent the tolerance range of the various taxa.

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Biological Time

Biological Rhythms and Endocrine Function. Proceedings of a conference, Columbia, Mo., Oct. 1973. LAURENCE W. HEDLUND, JOHN M. FRANZ, and ALEXANDER D. KENNY, Eds. Plenum, New York, 1975. x, 194 pp., illus. $19.50. Advances in Experimental Medicine and Biology, vol. 54.

The role of hormones in biological rhythms is a subject of intense interest to biologists in general and to endocrinologists in particular. The demonstrations of biological rhythms in practically all forms of life have introduced a new dimension, biological time, that demands as much consideration as biological space and form. The contributions in this volume, the proceedings of the Midwest Conference on Endocrinology and Metabolism, reveal some of the potential and much of the complexity of the new three-dimensional approach to biology. Although they are not considered in an organized manner, several general concepts emerge. The daily or circadian rhythm is basically a cellular phenomenon. Cellular rhythms are synchronized so that they produce tissue and organismal rhythms of metabolism and behavior. The circadian rhythms at all levels of organization often persist in the absence of obvious environmental cues, but the phases of the rhythms are usually entrained by the daily schedule of light and dark. The neuroendocrine system has a central role in organizing cellular rhythms, mediating environmental entrainment, and adjusting the individual to its environment. Interactions of the circadian rhythms in turn are responsible for the establishment of conditions that make up longer cycles such as those found during the rodent estrous cycle and during annual cycles.

Because the adrenal cortex has multiple vital influences, it is appropriate that a considerable effort has been made to understand the corticosteroid rhythms. Three contributions are focused on the regulation of these rhythms. The consensus is that the circadian rhythm of plasma corticosteroid concentration is driven by a rhythm of pituitary ACTH release that in turn is entrained by a periodic release of hypothalamic releasing hormone. Although this renowned pathway has the legitimacy of familiarity, the reader might bear in mind that the proofs for it are for the most part correlative.

Because corticosteroid rhythms synchronize many other rhythms, it is regrettable that more attention is not given to their synchronization functions. Discussion of these would have been of special interest in the light of studies cited by Halberg that demonstrate that timed activities, such as feeding, can alter the corticosteroid rhythm. "When we eat is what we are" could be a topic of interest for a future conference.

Whereas the adrenal cortex has received considerable attention because its importance is well recognized, the pineal has drawn much attention, it appears, for opposite reasons. Given the difficulty of interpreting the literature, Reiter does an excellent job of reviewing the roles the gland may have in reproduction. Despite considerable effort, it still is uncertain whether melatonin is the principal antigonadotrophic substance produced by the pineal. If melatonin is indeed a physiologically significant hormone, then the evidence that Lynch cites concerning stress-induced changes in melatonin production is of interest. Reiter argues that the pineal has a role in regulating the annual cycle of reproduction. This idea has merit for the hamster, but the reader would do well to resist any invitation to accept such a generalization as apropos for all vertebrate species.

If the reader is searching for a careful, seasoned appraisal of hormone rhythms he may be disappointed by this volume. An emphasis on the pineal and adrenal is balanced by a lack of consideration of the thyroid and other parts of the endocrine system. In addition, researchers often have more enthusiasm for the potential of their fields of interest than can be justified. It is not unusual to find that data of dubious

significance become the basis for a universal doctrine within a sentence or two. The reader should accept these foibles as necessary ingredients of the creative process and assign to himself the task of evaluation. In any event, an interested reader has little choice because very few texts in physiology and endocrinology provide an acceptable coverage of this important topic.

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Reproductive Biology

Physiology and Genetics of Reproduction. Proceedings of a symposium, Salvador, Brazil, Dec. 1973. ELSIMAR M. COUTINHO and FRITZ FUCHS, Eds. Two volumes. Part A. xxii, 418 pp., illus. $32.50. Part B. x, 454 pp., illus. $32.50. Plenum, New York, 1974. Basic Life Sciences, vols. 4A and 4B.

The tone of this publication is admirably set in the introductory paper by R. V. Short, who notes that "we must have a glimpse into the future to see whether our existing biological mechanisms are compatible with the reproductive restraints that we shall be increasingly forced to impose on ourselves." The two-volume work proceeds to examine these biological mechanisms in 54 brief, informative papers, many including comprehensive tables of data and relevant commentary by outstanding experts. Each paper has a useful summary and an excellent bibliography.

The principal emphasis of the papers is on the physiological aspects of reproduction, but a dozen or so transmit relevant concepts of basic and applied genetics. Of particular note are the lucid discussion of the structure of mammalian chromosomes by D. E. Comings, the ultrastructural analysis of rRNA (ribosomal RNA) genes and RNA synthesis on lampbrush chromosomes of amphibian oocytes and other cells by O. L. Miller, Jr., *et al.*, the quantitative electron microscopic analysis of ribosomal populations in mouse oocytes as related to nucleic acid and protein synthesis in oogenesis by R. B. Garcia *et al.*, and the analysis of DNA polymerase and oocyte enzymes in fertilization in lower forms by B. De Petrocellis *et al.* Comings details evidence, his own and that of others, concerning the idea that essential genes are relatively rich in glycine and cysteine and well methylated. The contributions of the types of heterochromatin and of proteins, especially nonhistone proteins, to chromosome banding patterns are analyzed. The arguments presented on this controversial and unsettled matter are as cogent now as they were at the time of the symposium. Miller's and De Petrocellis's papers point up the fact that progress in the analysis of genetic activity in oocytes is still very much confined to lower forms. Although some papers, such as Garcia's, have appeared that give important evidence concerning the possibility of gene amplification, the synthesis of RNA or protein prior to or during the progression from diakinesis to second metaphase, and the timing of bursts of DNA synthesis in mammalian oogenesis, the story is obviously far from complete. The relevance of such data to problems of contraception and mutation in the mammal is obvious. The controversy concerning the effects of androgen on the survival of mammalian female germ cells is well analyzed by M. F. Lyon in a discussion of the sex determination system in mammals. A wealth of well-documented information on human chromosomal errors and reproductive failure is presented from their particular perspectives by K. Benirschke in chapter 6 (part A), and by A. and J. Boué in chapter 48 (part B), each annotating the data with pertinent constraints concerning the significance of some published reports. Substantive basic arguments for explaining some of the phenomena summarized by these authors are made by R. A. Beatty in the section on genetic aspects of spermatozoa, where he documents experiments on the diploidy of human spermatozoa and the question of digyny. Evidence from embryogenesis in mutant mice, in which early fetal wastage often occurs, is clearly and imaginatively presented by A. McLaren.

Among the many papers on reproductive physiology is E.-E. Baulieu's lucid account of his views on the "forward approach" to the study of the mechanism of steroid hormone action. In this rapidly changing field evidence has been published by other authors since this symposium that does not entirely support some of the proposed ideas, but a strong case for many of the described features can still be made. The need for a suitable infrahuman primate model for human reproduction is exemplified by N. Hagino's paper on the baboon. Although detailed data on steroid and gonadotropin levels and interactions and on the physiology of menstruation, ovulation, and luteinization in other species are available, it is the application of such information to the production of these rapidly disappearing animals that is beginning to emerge at the top of many priority lists. The ancient, provocative problem of specificity in fertilization of mammals is updated by C. E. Adams. The marked differences in the success of reciprocal crosses, for example between goat and sheep, is discussed and data from experiments in vitro and in vivo are reviewed. The critical role of the zona pellucida and the vitelline membrane in many species emerges very clearly. The contractility behavior of the human fallopian tube is analyzed in a practical manner by H. Maia *et al.*, by comparison with findings in rabbit oviduct, and the variable responses at different times of the menstrual cycle are recorded. G. C. Liggins contributes an appropriate final chapter, a presentation of the apparently critical role of prostaglandin $F_{2\alpha}$ in parturition in sheep and its potential relevance to human birth mechanisms. This unfinished narrative has been developed considerably since this meeting by the work of McDonald and others. This year may see its final resolution.

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Genetic Data

Handbook of Genetics. ROBERT C. KING, Ed. Vol. 1, Bacteria, Bacteriophages, and Fungi. xvi, 676 pp., illus. $37.50. Vol. 2, Plants, Plant Viruses, and Protists. xii, 632 pp., illus. $35. Plenum, New York, 1974.

The linkage map is the heart of genetics in any organism. It is the representation of the functional units (genes) as they are arranged on the chromosomes. Linkage tests can resolve individual nucleotides as well as order genes over millimeter lengths of DNA. Every geneticist adds information to the map, which thus represents the aggregate effort of many workers over many years. Good maps do not become obsolete, only more complete.

If a geneticist is fortunate enough to be working with an organism like *Escherichia coli*, *Salmonella typhimurium*, *Saccharomyces cerevisiae*, or *Drosophila melanogaster*, the map adorning his wall will be the same as that used by all his colleagues because of the energy and effort of scientists (Taylor, Sanderson, Mortimer and Hawthorne, and Lindsley and Grell, respectively) who have undertaken the thankless task of compiling and publishing comprehensive genetic maps.

There are relatively few organisms about which enough genetic information exists to make an attempt to compile a comprehensive map worthwhile. Even among these genetically tractable species, only a small proportion have generally agreed-upon maps, and one often must wade through a swamp of unconnected literature in order to find linkage relation-